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13. ABSTRACT (Maximum 200 words)

It is an understatement that information in general arrives in conditional form. In fact, unconditional information can always be considered as the special case where the antecedent is universal. Nevertheless, it is surprising how little progress has been made in developing a full logic of conditional expressions, compatible with traditional conditional probability techniques. Recently, this problem has begun to be addressed by a number of researchers, who have commonly agreed that, as a basis, conditional events (a|b), where a and be are ordinary unconditional ones lying in some sample space (boolean or sigma-algebra), should be interpreted as intervals of events (or their logical equivalence) [a•b, b' v a•b], relative to the usual event or set partial order ≤. Following this a number of conditional event algebras have been derived/proposed, possessing several desirable mathematical-logical properties and relatively easy to implement. (See, e.g. Goodman, Nguyen, & Walker, *Conditional Inference and Logic for Intelligent Systems: A Theory of Measure-Free Conditioning,* North–Holland, 1991.) However, a major drawback with these algebras is that inherently they cannot be boolean. (At most, they can have an algebraic structure which is a Stone algebra—see the above reference.) This leads, in particular, to certain problems in relating this work to the standard numerically-oriented approach of conditional probability, including the modeling of random variables and higher order conditional forms.

Recently, a breakthrough was obtained in the development of conditional event algebra, by replacing the interval of events basis by a joint countable product probability space approach. Although computationally more intense than the previous approaches, this has not only provided solutions of the above-mentioned problems of modeling, but has yielded a basic
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tie-in with conditional likelihoods. That is, if a_i, b_i are ordinary events, $i = 1, \ldots, n$ and conjunction $\cdot$ refers to the product space conjunction, then for any probability measure P for which the (a_i, b_i) are mutually independent pairs, then the usual joint product conditional likelihood form can be expressed as

$$\prod_{i=1}^{n} P(a_i \mid b_i) = \hat{P}((a_1 \mid b_1) \cdot \ldots \cdot (a_n \mid b_n)),$$

where $\hat{P}$ is the extension of P to the countable product space setting. Since the problem of determining the most appropriate likelihood form for non-independent conditionals is still an open issue, does the above equation provide a new reasonable approach to the problem by using the associated conditional event algebra as in the equation? This paper also discusses a number of related issues, including bayesian updating.

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